2020 Post-Enumeration Survey Update

March 18, 2022
Census Scientific Advisory Committee

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Decennial Statistical Studies Division

The data in this presentation have been cleared for release under DRB Numbers: CBDRB-FY22-136 and CBDRB-FY22-137.

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Outline

1. Status Update
2. Future Releases (Schedule and Tables)
3. Census Coverage Results by Demographic Characteristics
4. Overcoming Challenges
5. PES Estimation Methods

Status Update

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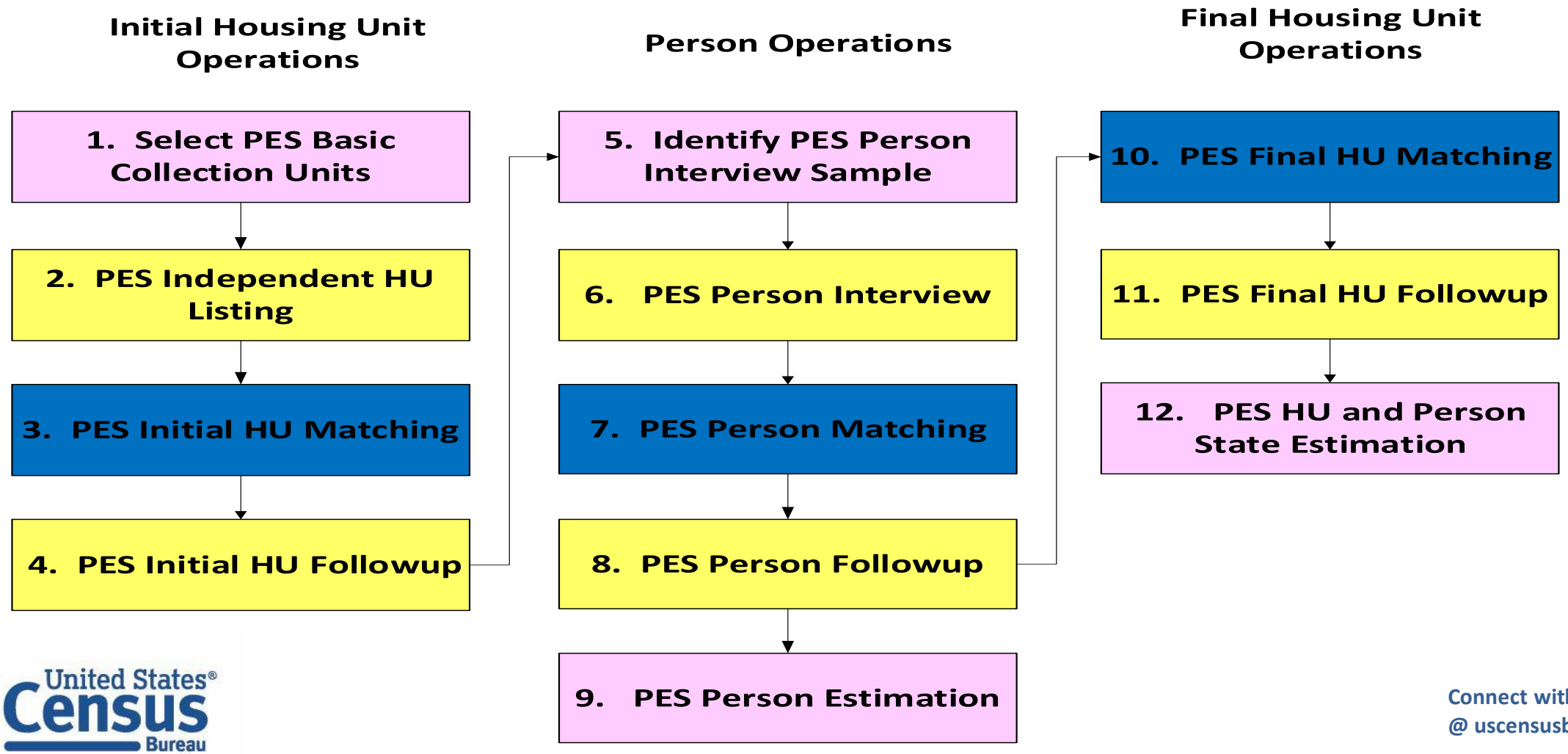
2020 PES Activities

Sampling and Estimation - Pink
Field Operations - Yellow
Matching Operations - Blue



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Revised Field Milestone Schedule

Operation	Original Dates		New Dates	
	Start	Finish	Start	Finish
Independent Listing	1/16/2020	3/13/2020	1/16/2020	3/20/2020
Initial HU Followup	5/6/2020	6/19/2020	7/30/2020	9/21/2020
Person Interview	6/17/2020	9/18/2020	9/23/2020	12/18/2020
Person Interview Reopen			2/11/2021	3/20/2021
Person Followup	2/3/2021	3/26/2021	6/14/2021	9/17/2021
Final HU Followup	5/19/2021	6/18/2021	11/29/2021	2/28/2022

Operations in blue are complete.
Dates include reinterview.

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Future Releases: Schedule and Tables

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Schedule to Release Coverage Reports

March 10, 2022

- National Census Coverage Estimates for People in the United States by Demographic Characteristics

Summer 2022

- Census Coverage Estimates for People in the United States by State and Census Operations
- Estimates of Coverage for Housing Units in the United States
- Estimates of Coverage for Puerto Rico

Note: Breakdowns by characteristics, such as demographic groups or census operations, are provided only for the national estimates - not the state estimates.

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Tables in National Census Coverage Estimates for People in the United States by Demographic Characteristics First Release (March 10, 2022)

Demographic characteristics

- Age Group
- Age Group by Sex
- Sex
- Race (alone or in combination) and Hispanic Origin
- Tenure (own or rent housing unit)
- Relationship to Householder

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Tables in Census Coverage Estimates for People in the United States by State and Census Operations
Summer Release

Geographic areas (states)

- Region
- State

Census operations

- Response Mode (Internet, Paper, Nonresponse Followup, …)
- Nonresponse Followup Respondent Type (Head of Household, Household Member, Proxy, …)
- Nonresponse Followup Workload (Completed by Enumerator, Administrative Record, …)
- Coverage Improvement Universe (Selected, not selected)
- Response Rate Decile
- Type of Enumeration Area

Note: Breakdowns by characteristics, such as demographic groups or census operations, are provided only for the national estimates - not the state estimates.

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Schedule to Release Methodology Reports

March 10, 2022

- Source and Accuracy Statement: Person

Summer 2022

- Estimation Methods: Characteristic Imputation
- Estimation Methods: Addressing Missing Data for People

Summer 2022

- Estimation Design
- Estimation Methods: Addressing Missing Data for Housing Units
- Estimation Methods: Estimation of Net Coverage
- Estimation Methods: Estimation of Components
- Source and Accuracy: Housing Unit

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Census Coverage Results by Demographic Characteristics

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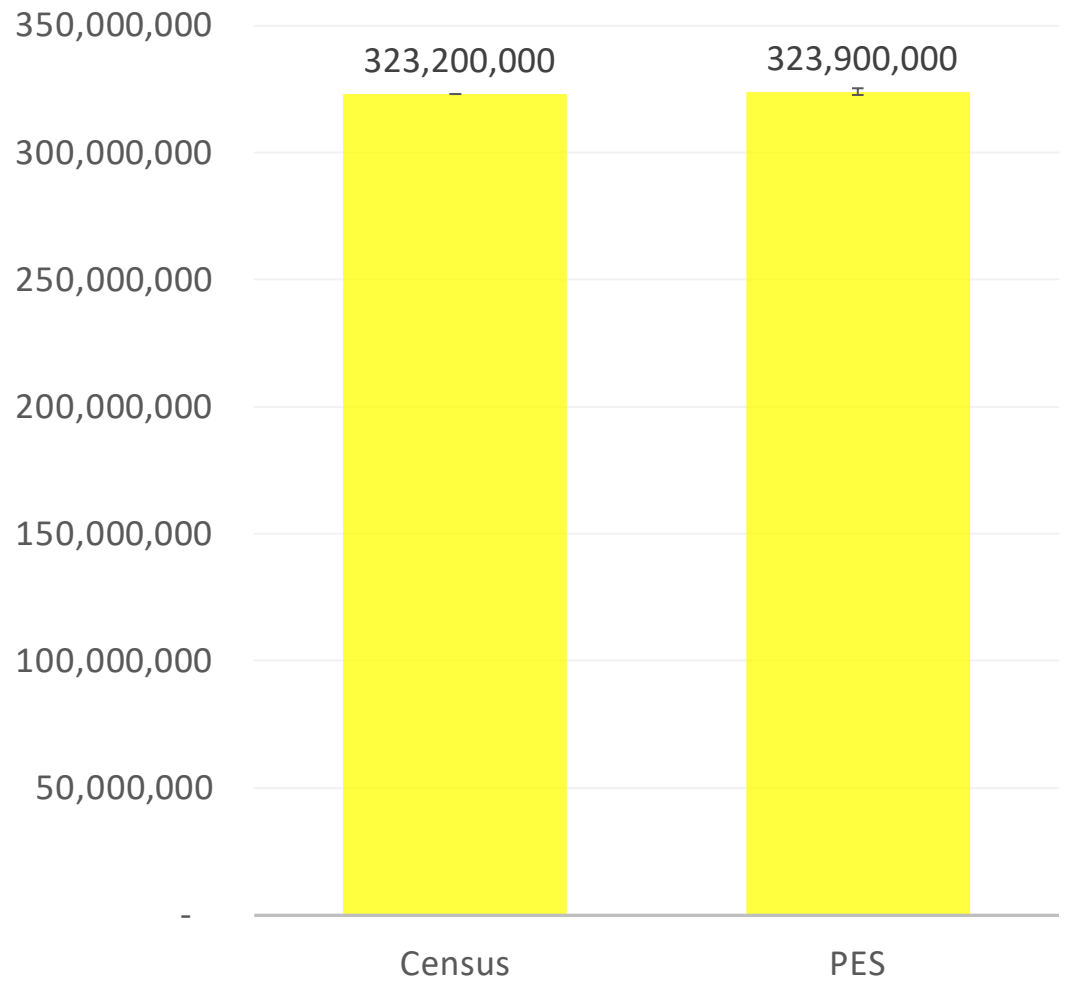
Coverage of the Census

Census Count of the Population	323,200,000
Estimate of the Population from PES	323,900,000
Net Coverage Error	-782,000
Percent Net Coverage Error	-0.24 %



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Numbers do not sum due to rounding.

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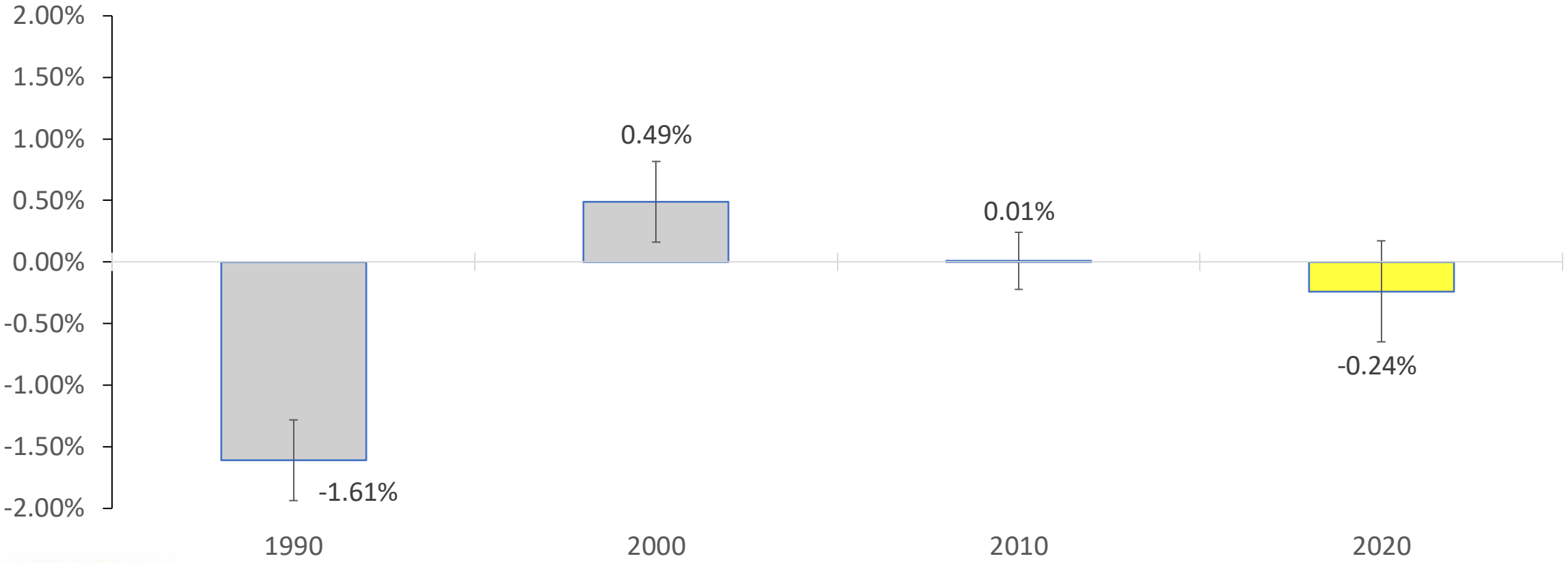
U.S. Total Percentage Net Coverage Error 1990 to 2020



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Percentage Net Coverage Error by Race and Hispanic Origin 2010 and 2020

Race or Hispanic Origin	2010	2020
Total	0.01	-0.24
Race alone or in combination		
White	0.54*	0.66*
Non-Hispanic White alone	0.83*	1.64*
Black or African American	-2.06*	-3.30*
Asian	0.00	2.62*
American Indian or Alaska Native	-0.15	-0.91*
On Reservation	-4.88*	-5.64*
American Indian Areas Off Reservation	3.86	3.06
Balance of the United States	0.05	-0.86*
Native Hawaiian or Other Pacific Islander	-1.02	1.28
Some Other Race	-1.63*	-4.34*
Hispanic or Latino	-1.54*	-4.99*

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Percentage Net Coverage Error by Age for Children 1990 to 2020

Age	1990	2000	2010	2020
0-4	-3.18*	0.46	-0.72*	-2.79*
5-9			0.33	-0.10
10-17		1.32*	0.97*	-0.21

*Net coverage error is statistically significantly different from 0

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Percentage Net Coverage Error by Age and Sex for Adults 1990 to 2020

Age and Sex	1990	2000	2010	2020
18 to 29 Males	-3.30*	-1.12*	-1.21*	-2.25*
18 to 29 Females	-2.83*	1.39*	0.28	-0.98*
30 to 49 Males	-1.89*	-2.01*	-3.57*	-3.05*
30 to 49 Females	-0.88*	0.60*	0.42*	0.10
50+ Males	0.59*	0.80*	0.32*	0.55*
50+ Females	1.24*	2.53*	2.35*	2.63*

*Net coverage error is statistically significantly different from 0

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Percentage Net Coverage Error by Age and Sex Post-Enumeration Survey and Demographic Analysis

Age and Sex	2020 PES	DA Low	DA Mid	DA High
0 to 4	-2.8*	-5.3	-5.4	-5.5
5 to 9	-0.1	-1.2	-1.4	-1.6
10 to 17	-0.2	-0.2	-0.6	-0.8
18 to 29 Males	-2.3*	0.7	0.1	-0.3
18 to 29 Females	-1.0*	1.8	1.3	0.9
30 to 49 Males	-3.1*	-2.8	-3.2	-3.9
30 to 49 Females	0.1	0.3	-0.2	-0.8
50+ Males	0.6*	1.1	0.2	-1.4
50+ Females	2.6*	3.1	2.2	0.5

*Net coverage error is statistically significantly different from 0

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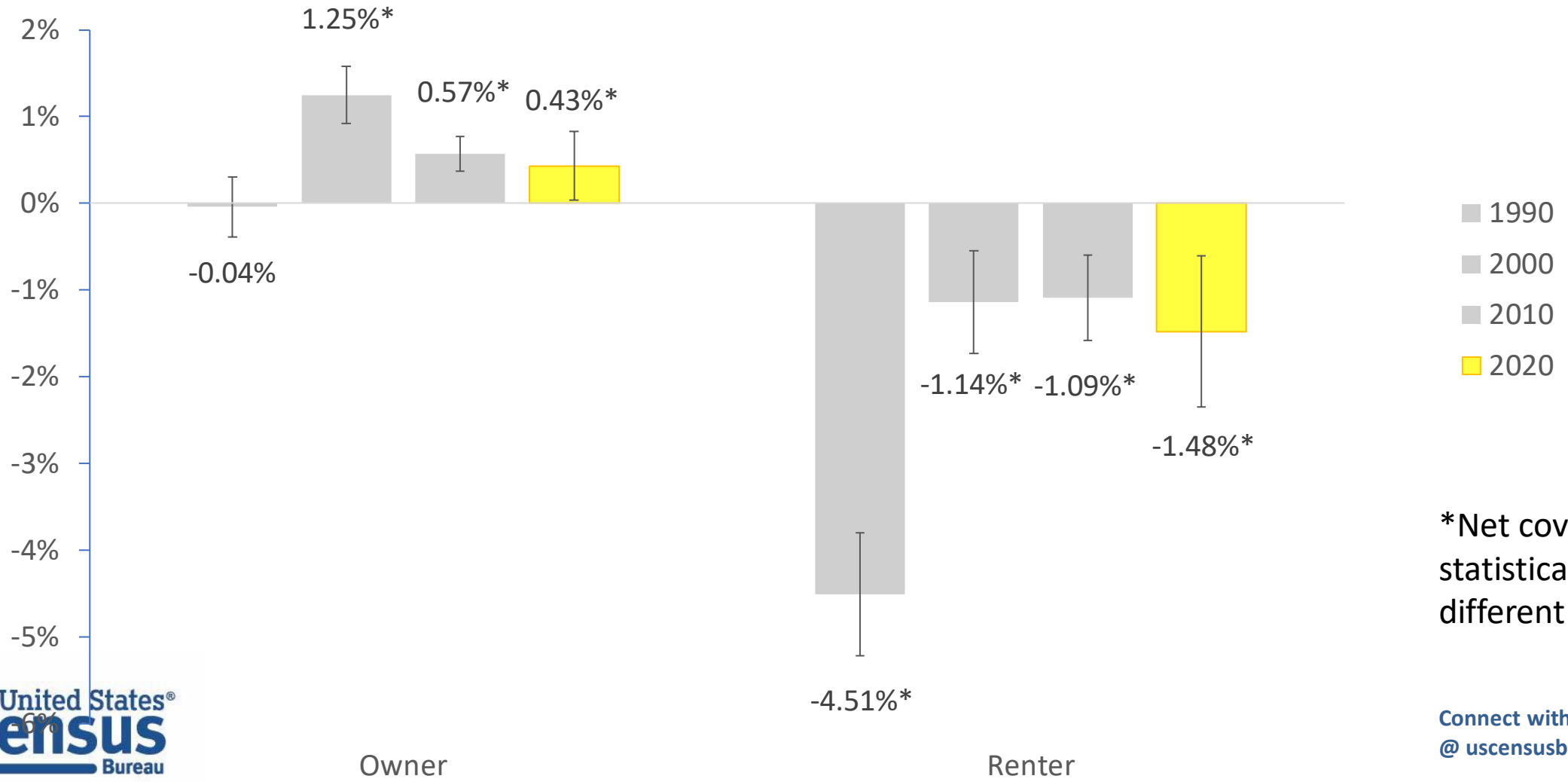
Percentage Net Coverage Error for People by Tenure 1990 to 2020



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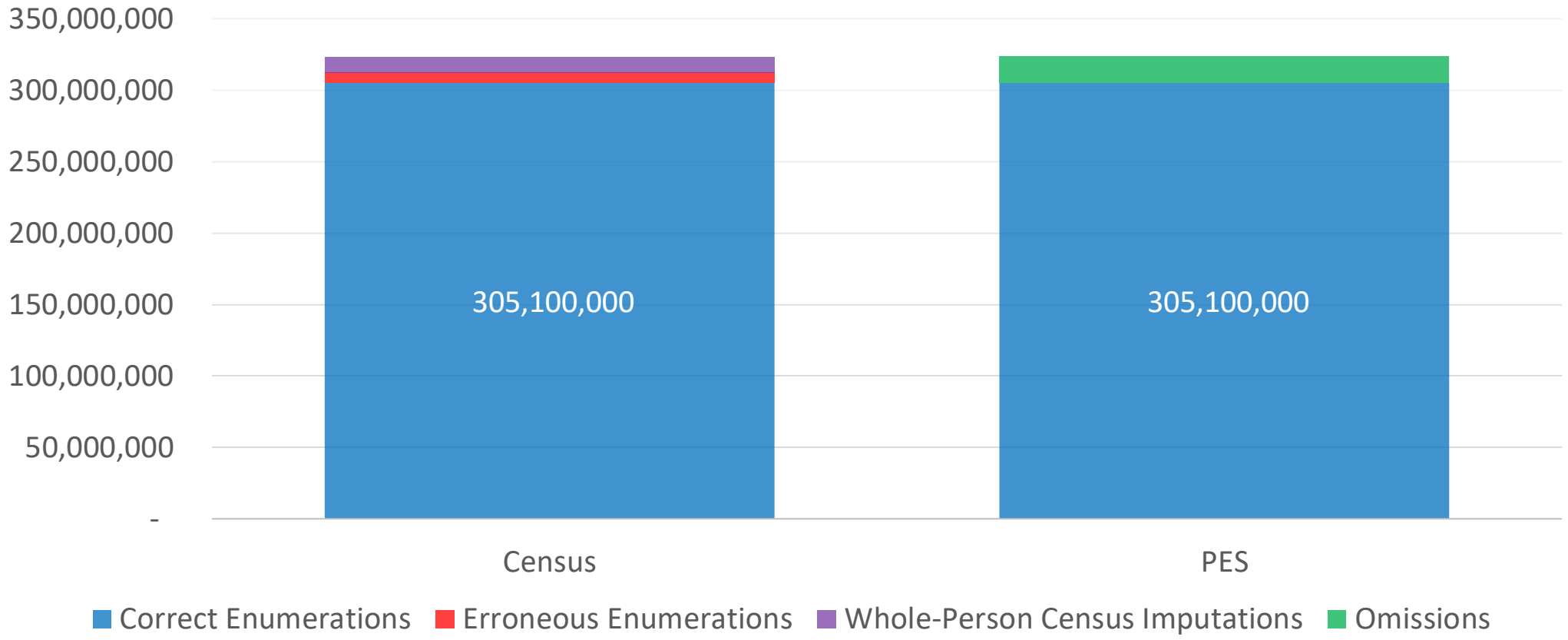
Components of the Census Coverage in 2020 Level



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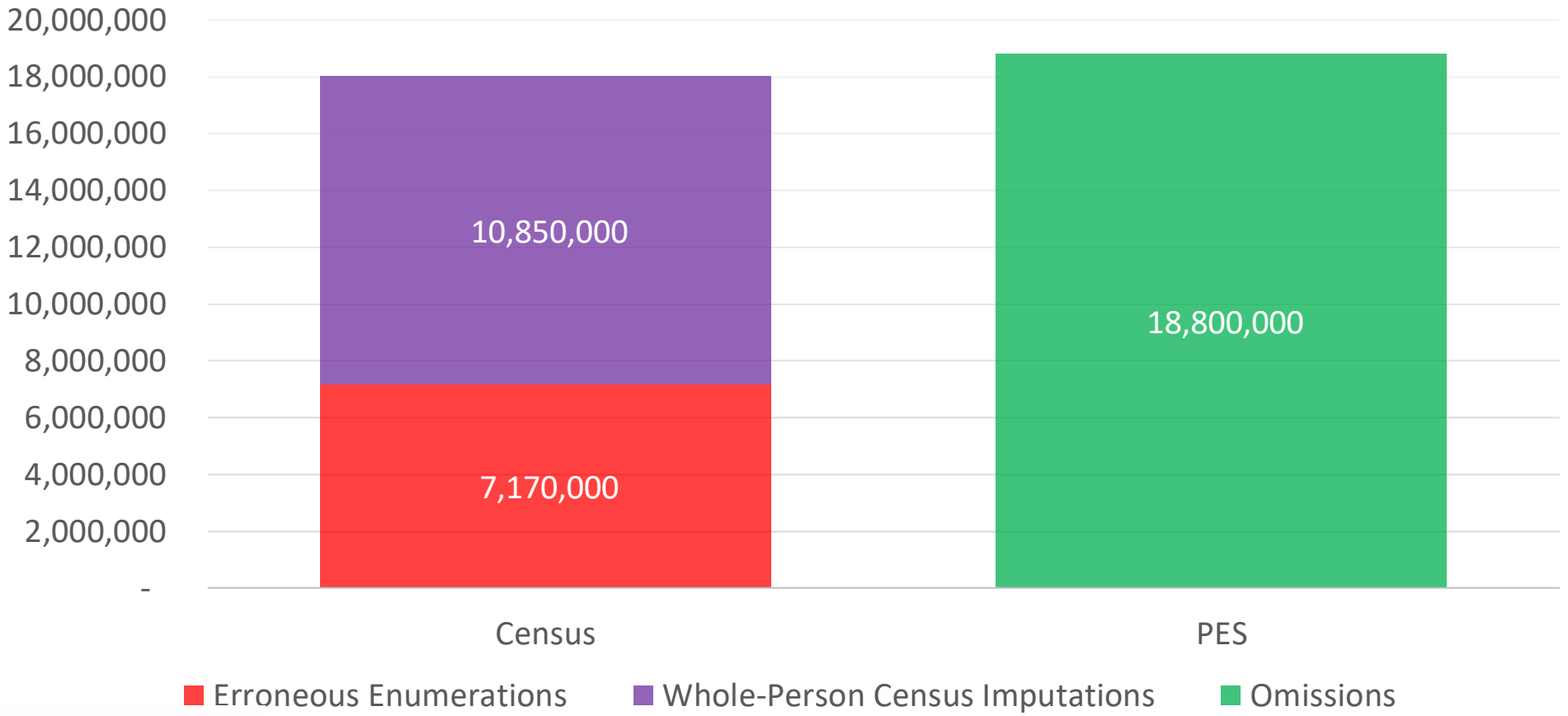
Components of the Census Coverage in 2020 Level



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U.S. People: Components of Census Coverage: 2010 and 2020 (in Thousands)

Component of Census Coverage	2010				2020			
	Estimate	Standard Error	Percent	Standard Error	Estimate	Standard Error	Percent	Standard Error
Census Count	300,700	-	100.0	-	323,200	-	100.0	-
Correct enumerations	284,700	199	94.7	0.07	305,100	145	94.4	0.04
Erroneous enumerations	10,040	199	3.3	0.07	7,167	145	2.2	0.04
Due to Duplication	8,251	194	**2.8**	0.06	5,170	129	**1.6**	0.04
For other reasons	1,520	45	0.5	0.01	1,997	88	0.6	0.03
Whole-Person Imputations	5,993	-	2.0	-	10,850	-	3.4	-

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Whole-Person Census Imputations (in Millions)

Whole-person Census imputations	2000		2010		2020	
	Count	Percent	Count	Percent	Count	Percent
Total	5.77	2.1	5.99	2.0	10.85	3.4
Population count already known	4.60	1.7	4.83	1.6	8.99	2.8
Population count missing	1.17	0.4	1.16	0.4	1.86	0.6

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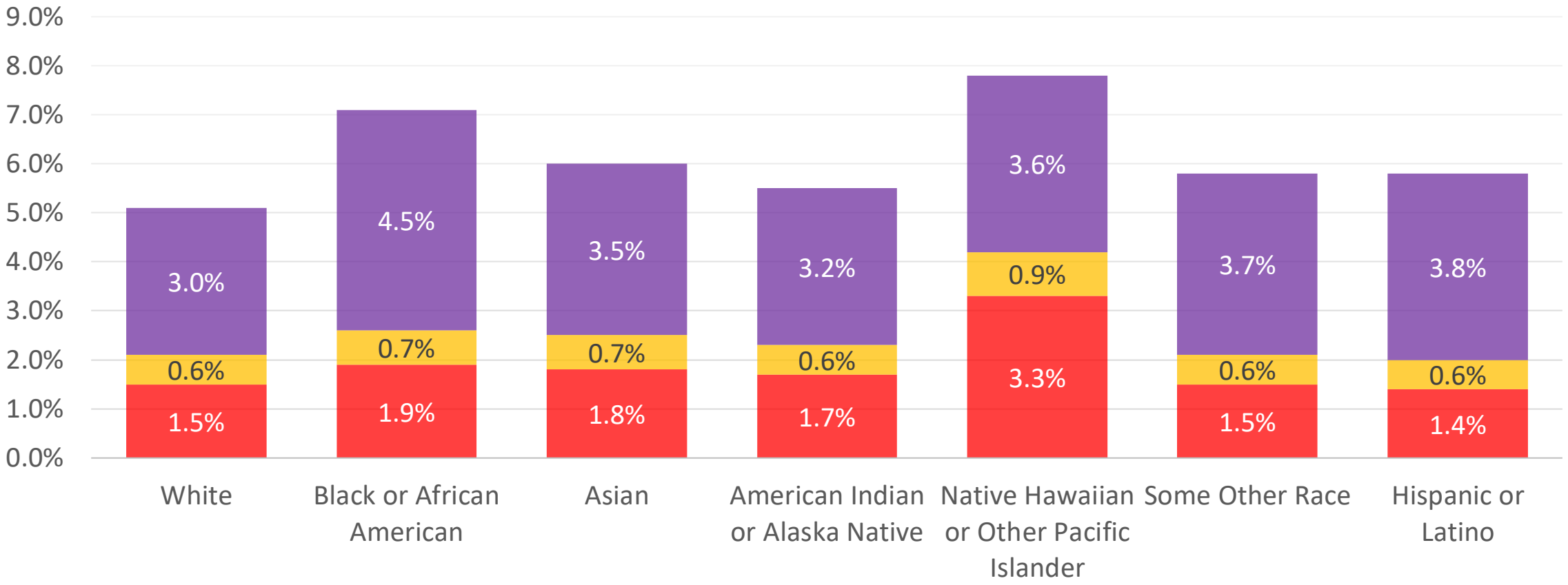
Percent Components of Census Coverage
Race (Alone or in combination) and Hispanic Origin



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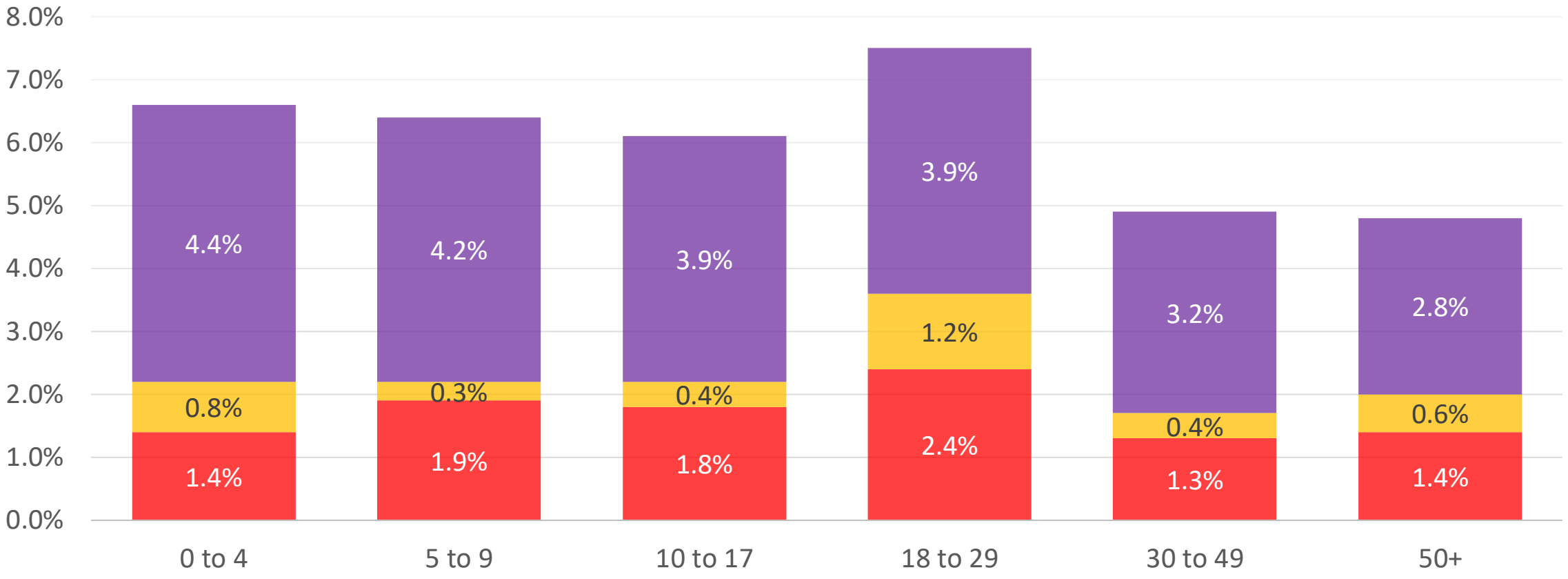
Percent Components of Census Coverage
Age Group



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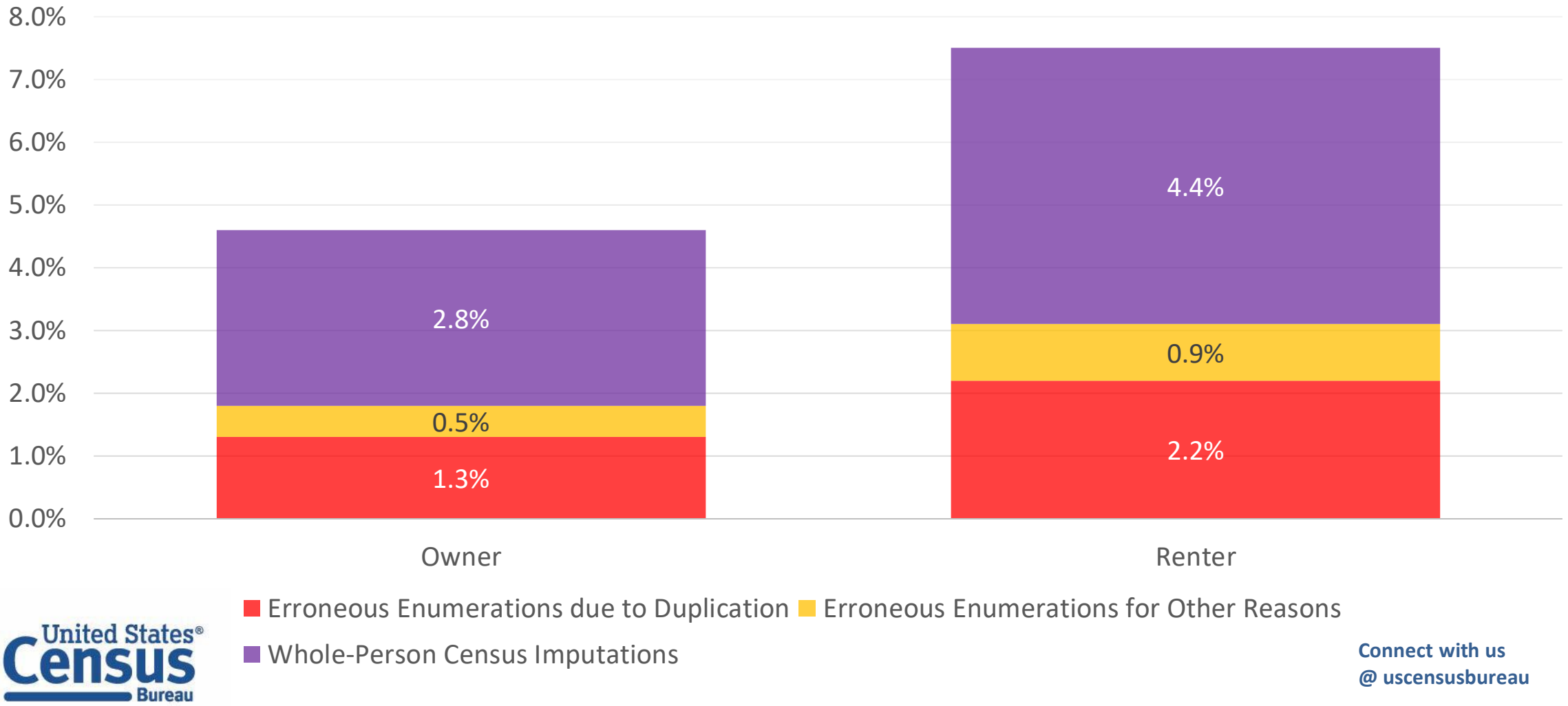
Percent Components of Census Coverage Tenure



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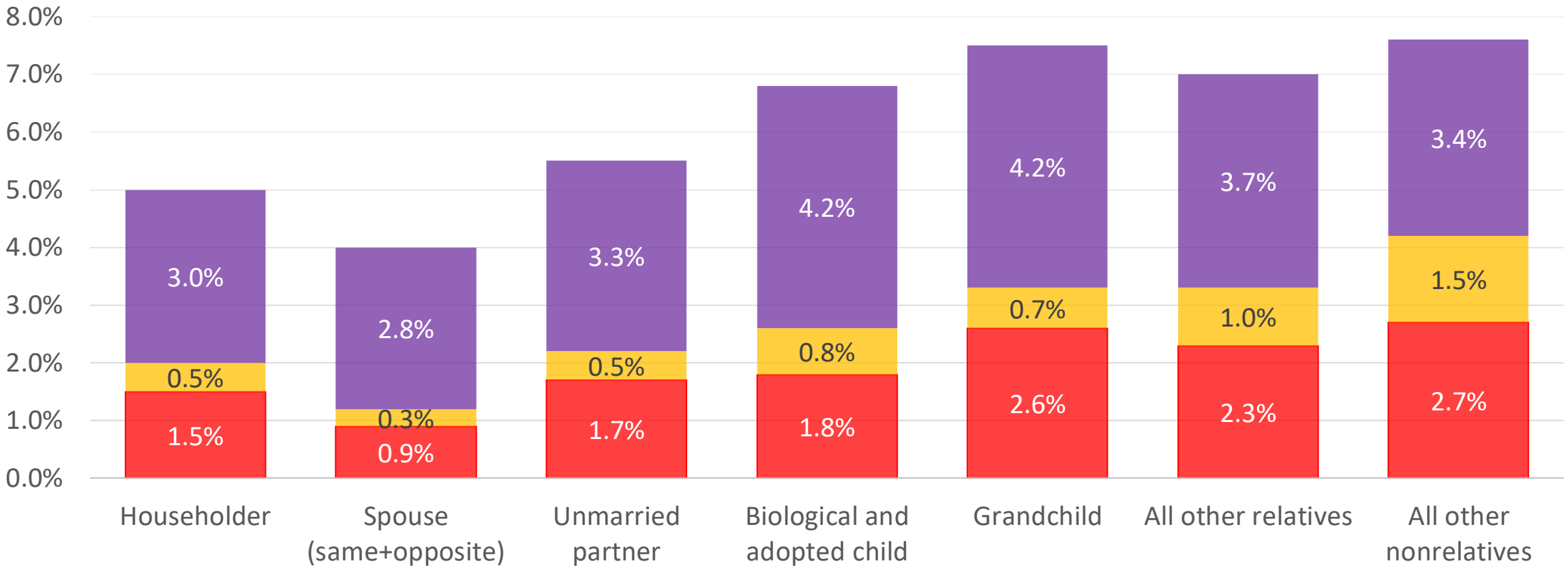
Percent Components of Census Coverage Relationship to Householder



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National Components of the PES Estimate (in Millions)

Component of PES Estimate	2010				2020			
	Estimate	Standard Error	Percent	Standard Error	Estimate	Standard Error	Percent	Standard Error
Estimate of Pop. From PES	300.7	0.43	100.0		323.9	0.82	100.0	
Correct Enumerations	284.7	0.20	94.7	0.1	305.1	0.15	94.2	0.24
Omissions	16.0	0.44	5.3	0.1	18.8	0.82	5.8	0.24

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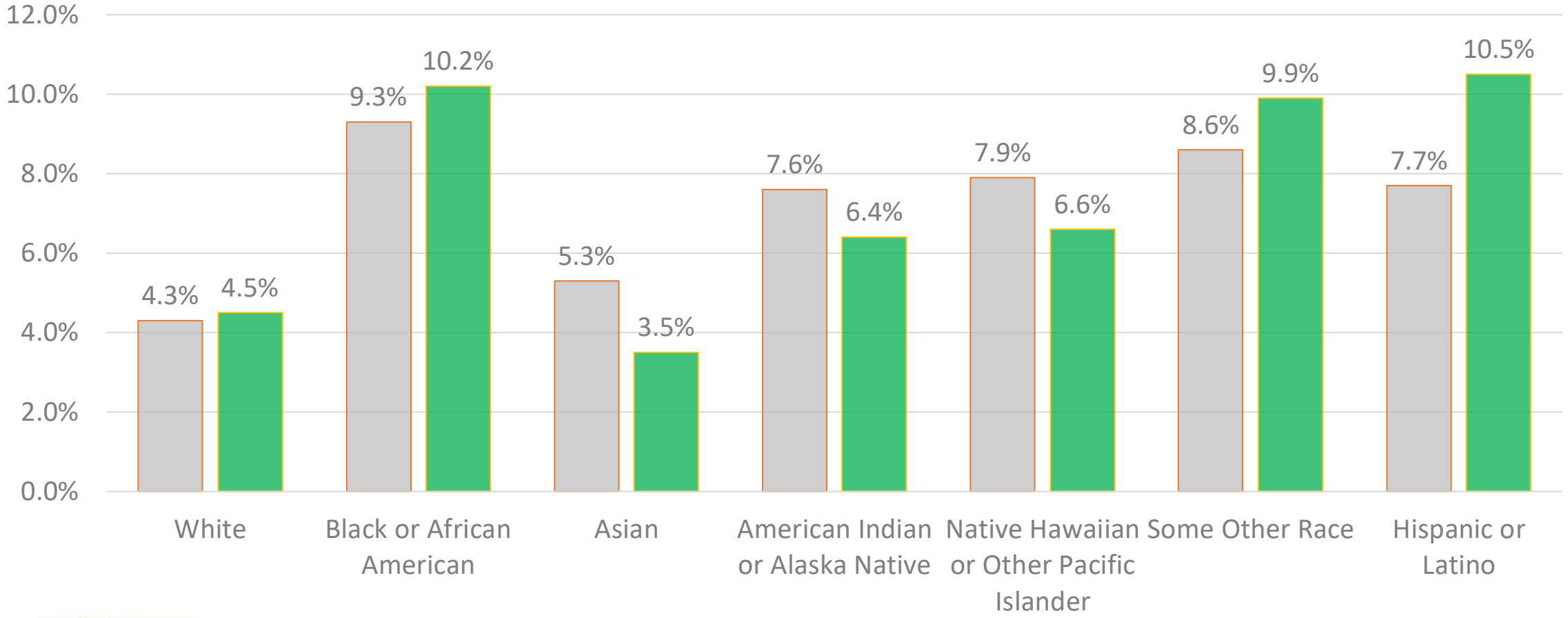
2010 and 2020 Census Omission Rates
Race (Alone or in Combination) and Hispanic Origin



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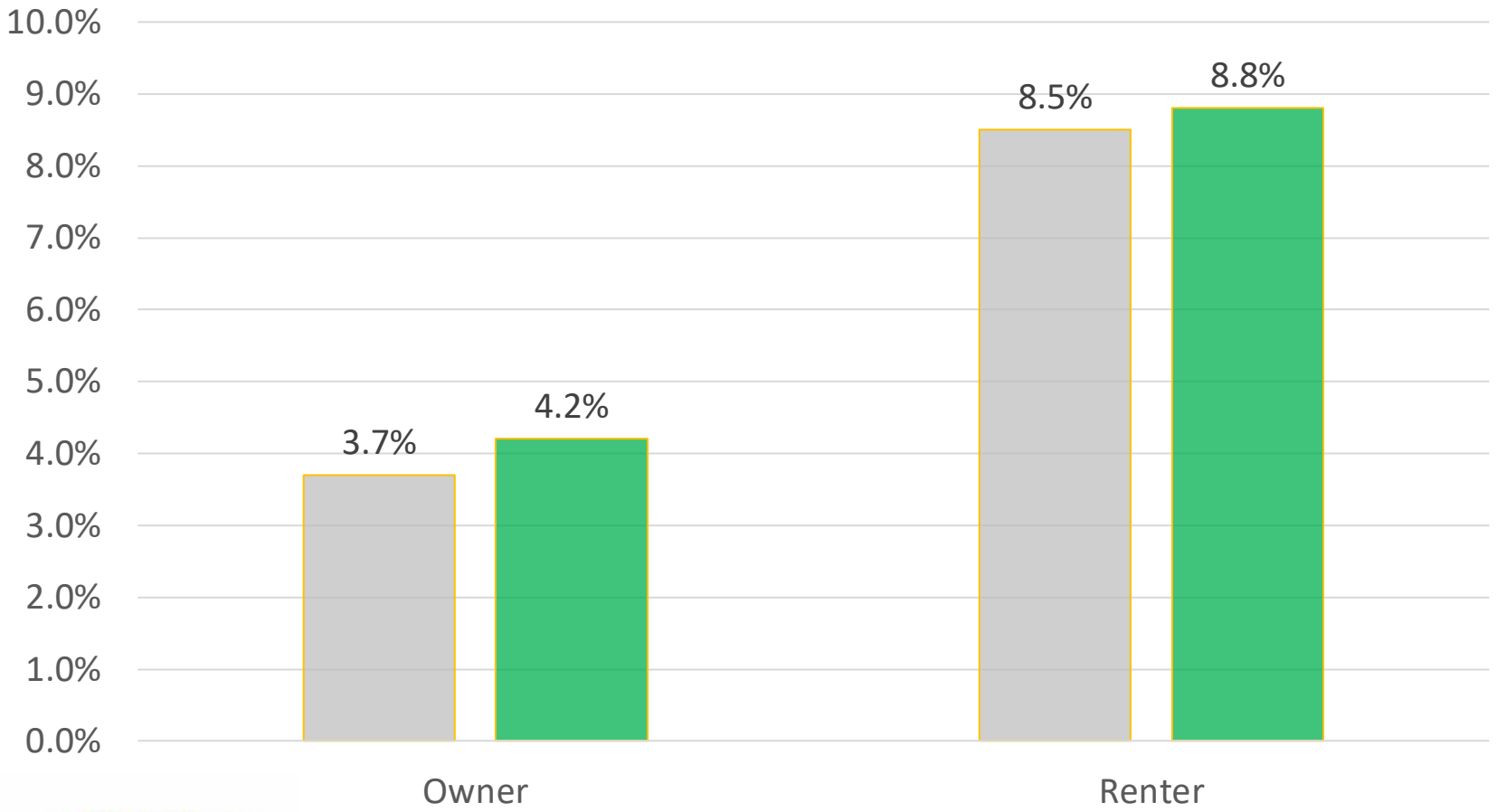
2010 and 2020 Census Omission Rates Owners and Renters



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Overcoming Challenges

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PES Challenges

- Global pandemic
- Delays to field work
  - Matching people who might not accurately report their census residence status
- Migration of many college students and others
- Some respondents did not respond to questions needed to match the PES to the Census
  - Matching people to the census with increased item nonresponse
- Training for clerical matching staff is extensive and schedule is tight

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PES Person Interview Response Rates for Occupied Housing Units (Unweighted)

Interview Outcome	2010		2020	
	Number	Percent	Number	Percent
Total Occupied Housing Units	145,000	100.0	137,000	100.0
Interview	140,000	96.6	114,000	83.2
Noninterview	5,300	3.7	23,000	16.8
Interview not conducted	2,300	1.6	4,900	3.6
Interview not sufficient	3,000	2.1	18,500	13.5

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PES Quality Design Features to Increase Data Quality

- Field operations
  - A sample of all PES interviews were reinterviewed (interviewed a second time) for a quality check. If the quality check failed, the original data were corrected by the reinterviewers
  - Large person follow-up workload to make sure we accurately identified matches, correct enumerations, and erroneous enumerations
  - Increasing response. We extended the end date for some interviews
- Clerical matching
  - A quality check was performed on a sample of work completed by each matcher, and corrections were made when necessary
- Estimation procedures
  - Performed nonresponse weighting and imputation to reduce nonresponse error

PES Estimation Methods

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PES Estimation Activities for Nonresponse

- Nonresponse adjustment at the HU-level was applied to person weights. A stratified propensity adjustment was the method used.

- Characteristic Imputation was used for missing demographic characteristics. The 2020 Census system and methodology for characteristic imputation was also used for the PES.

- Match status and correct enumeration status are imputed using logistic regression models.

- No calibration for net coverage since the PES creates a “benchmark.”

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P-Sample Estimation Methods

- Nonresponse Weighting
- Characteristic Imputation
- Match Status Imputation
  - Inclusion Status
  - Inmover Status
  - Match Status
- Weight Trimming
- Modeling Probability of Being a Match

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Noninterview Weighting Summary

GOAL

- Mitigate error introduced by non-response

METHOD

- Model interview propensities at the housing unit (HU) level with logistic regression
- Stratify HUs based on propensities and reallocate weights within strata

MODELS

- Non-American Indian Country (Non-AIC)
- Puerto Rico (PR)
- American Indian Country (AIC)

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Match Status Imputation
Inclusion Status
Inclusion Status

- For people with an unresolved inclusion status, impute the probability of inclusion in the P sample
- All unresolved inclusion status cases are also unresolved match status cases

Inmover Status

Match Status

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Match Status Imputation: Inmover Status

Inclusion Status

Inmover Status

- For people with unresolved mover status, impute probability of inmover status using logistic regression
- This was a weighted estimate in 2010
- Results of this model are input for the person match status model

Match Status

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Match Status Imputation:
Match Status

- For all people with unresolved match status, impute a probability of a match

$$P(Match) =$$
$$P(Inmov) * P(Match \mid Inmov) +$$
$$P(Nonmov) * P(Match \mid Nonmov)$$

- Two records for each imputed enumeration are created and the person weights are distributed to each status proportional to the predicted probability

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E-sample Estimation Methods

- Characteristic Imputation
- Enumeration Status Imputation
  - Imputation for Net Coverage
  - Imputation for Components of Coverage
- Weight Trimming
- Modeling Probably of Being Correctly Enumerated

Correct Enumeration Status
Enumeration Status

- For unresolved people, impute the probability of correct enumeration using a logistic regression model.
- Two records for each imputed enumeration are created and the person weights are distributed to each status proportional to the predicted probability.

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Current Version of Dual-System Estimator (DSE)

$$\widehat{TOT_D} = \sum_{j \in D} \left[\pi_{dd,j} \, {}^{\pi_{\mathrm{ce},j}}/_{\pi_{\mathrm{m},j}} \, SR_{ag} \right]$$

Where

D is the estimation domain (total, tenure status, age/sex groupings, etc.)

j is a census enumeration

$\pi_{dd,j}$ is the predicted probability census case j is data-defined

$\pi_{cd,j}$ is the predicted probability that the census case is a correct enumeration

$\pi_{m,j}$ is the predicted probability that the census case was matched

SR_{ag} is the sex ratio adjustment

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Discussion Questions

- Our current approach to conducting a PES has an assortment of complex and extensive field and matching operations. What alternative designs or changes does CSAC recommend to lower the risk of field or clerical problems?

- In an effort to preserve the independence assumption required for dual-system estimation, the 2020 PES limited the use of administrative records that were used for the Census. How can the PES use administrative records to help measure coverage of the census?

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QUESTIONS?

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Backup Slides

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How PES Estimates are Created

		Enumerated in PES?	
		YES	NO
Enumerated in Census?	YES	Found in Both	Missing in PES Found in Census
	NO	Missing in Census Found in PES	Missing in Both

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